



Triboelectric Separation of Fine Coal Using an Electric Field Fluidized Bed

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FLUIDIZATION XVI

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OUTLINES

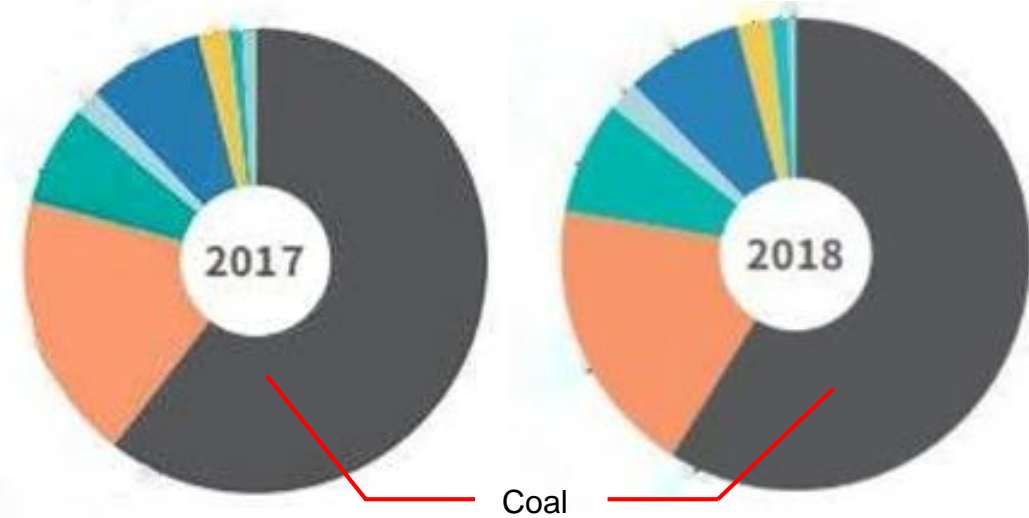
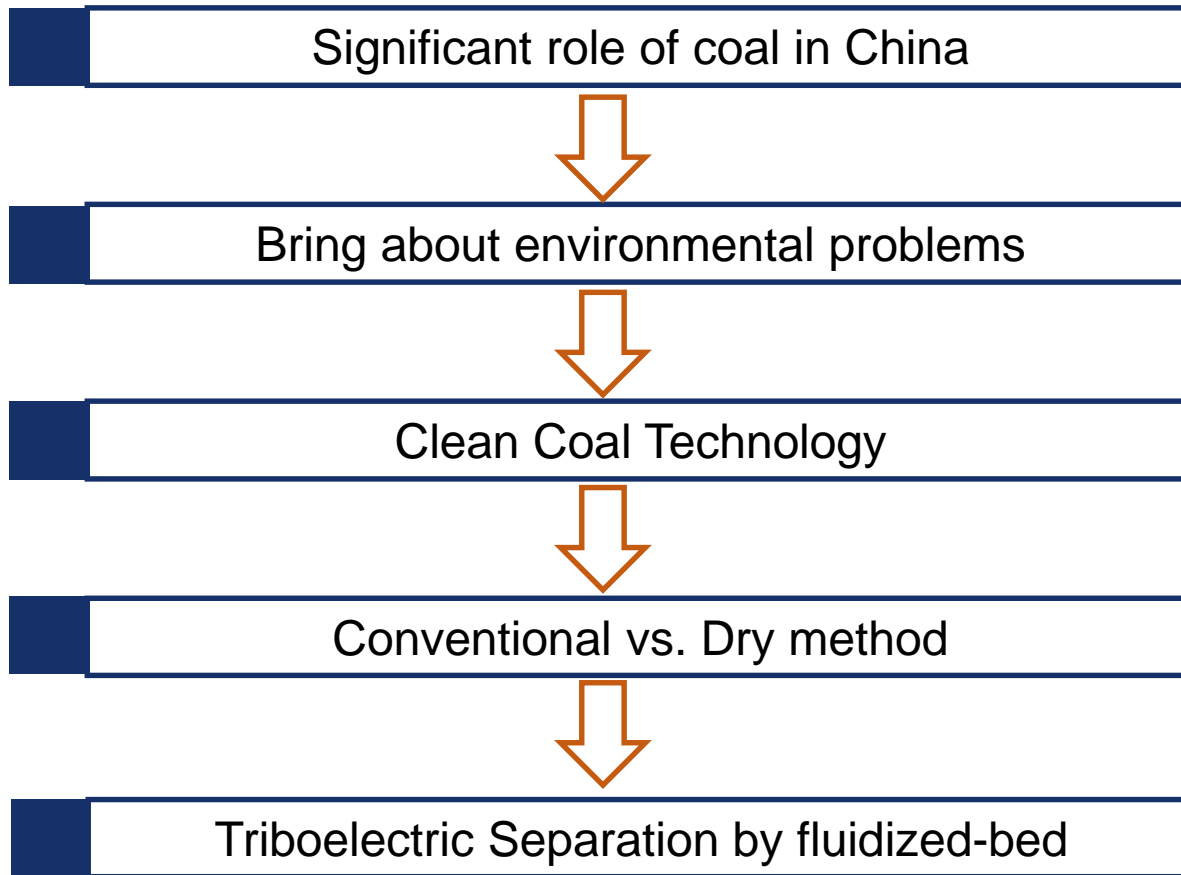


Fig.1 Energy consumption in China (2017 & 2018)



Fig.2 Environmental problems in China

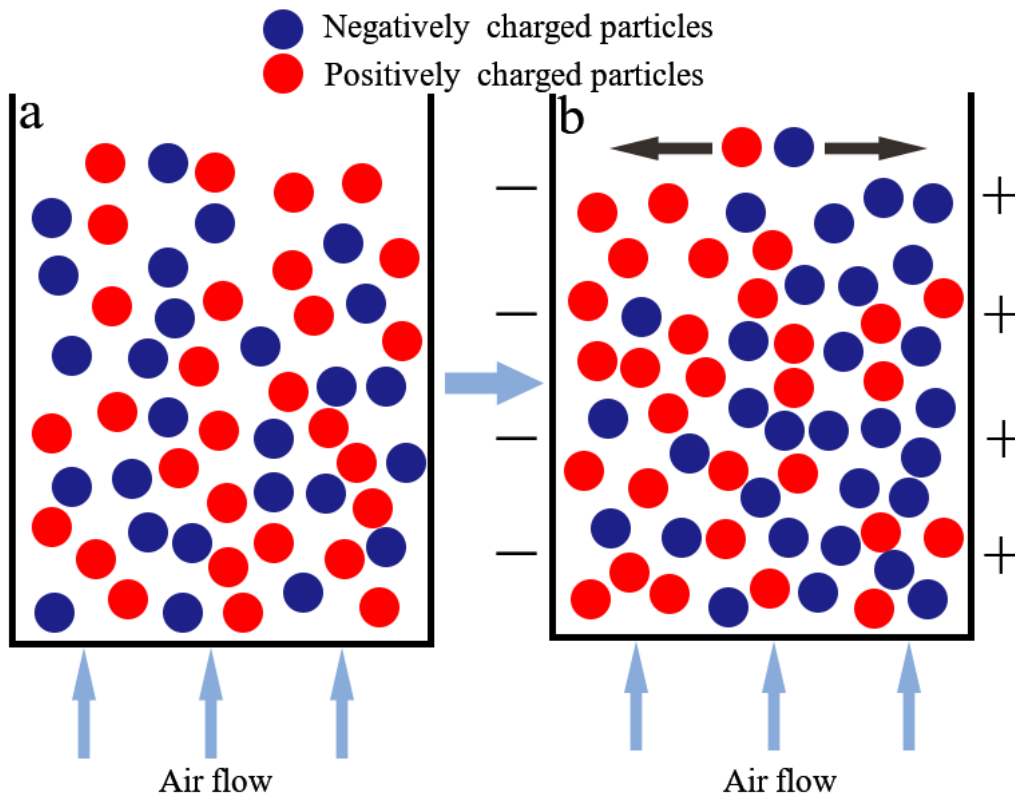


Fig.3 Working principle

a) Without electric field

b) With applied electric field

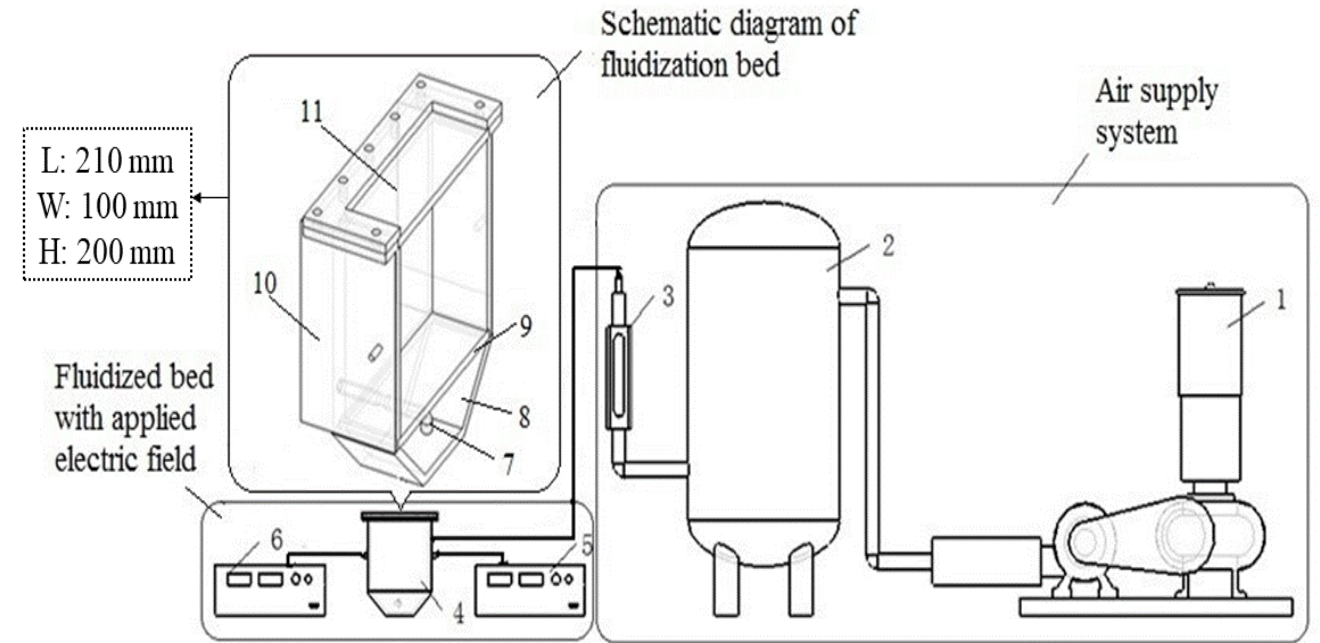


Fig.4 Experimental setup

1-Roots blower 2-Air tank 3- Flowmeter 4-Fluidized bed
5-High voltage plate (positive) 6-High voltage plate (negative)

7-Windpipe 8-Air distributor

9-Air distributor plate 10- Electrode plate 11-Cover board

Materials

(1) Raw coal
ash content, 15.61%

(2) Low ash coal + quartz
(3:1, wt%)

Operating condition experiments

(1) High voltage

(2) Gas velocity

(3) Fluidization time

Charging property test

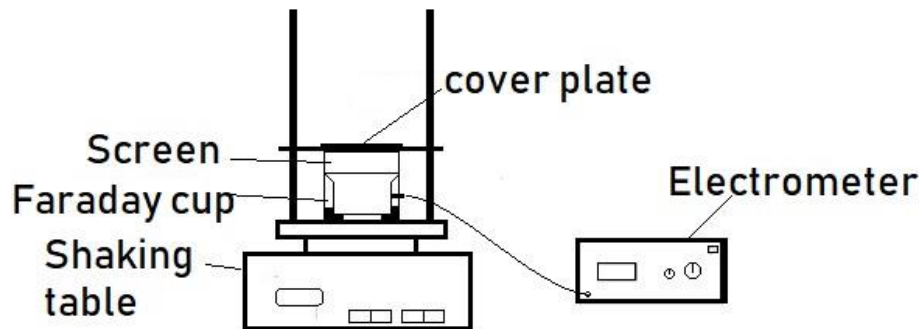


Fig.5 Charging property test system

Enrichment of raw coal

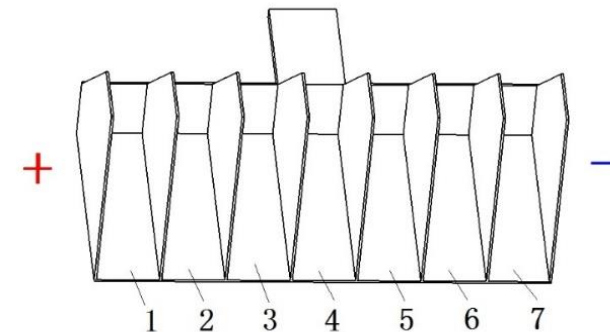


Fig.6 Diagram of product collector

Charging property

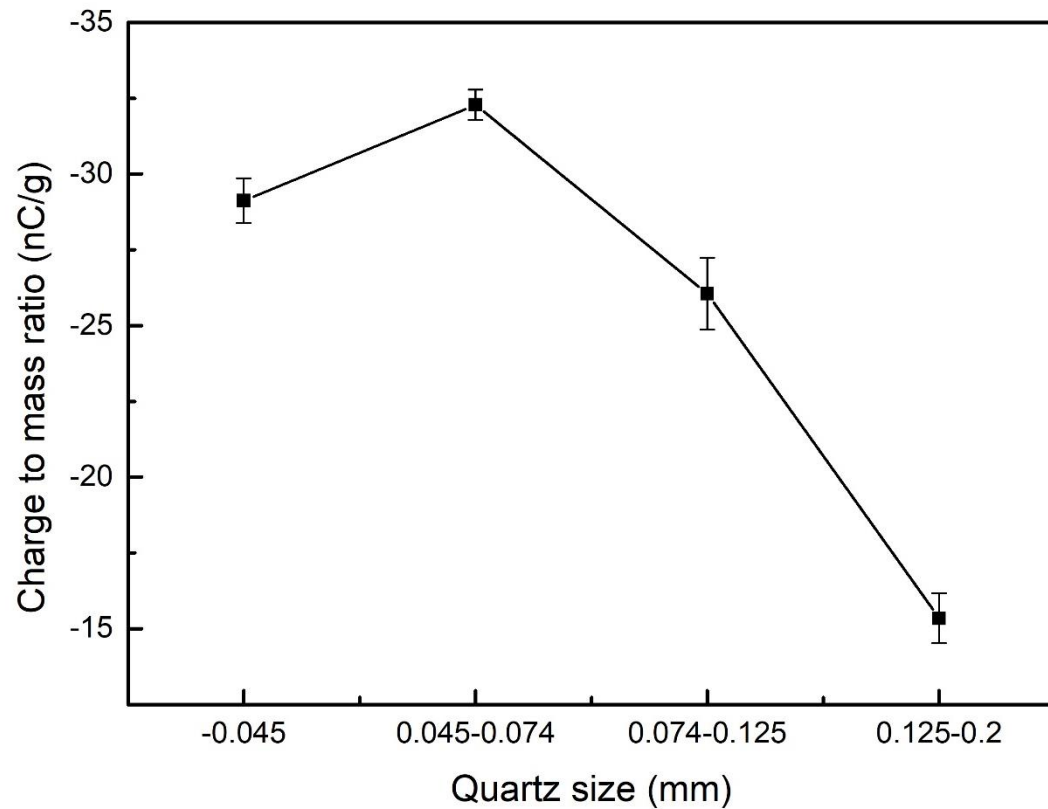


Fig.7 Quartz with different size charging with coal

Particle size of 45-74 μm gains larger tribocharging.

High voltage

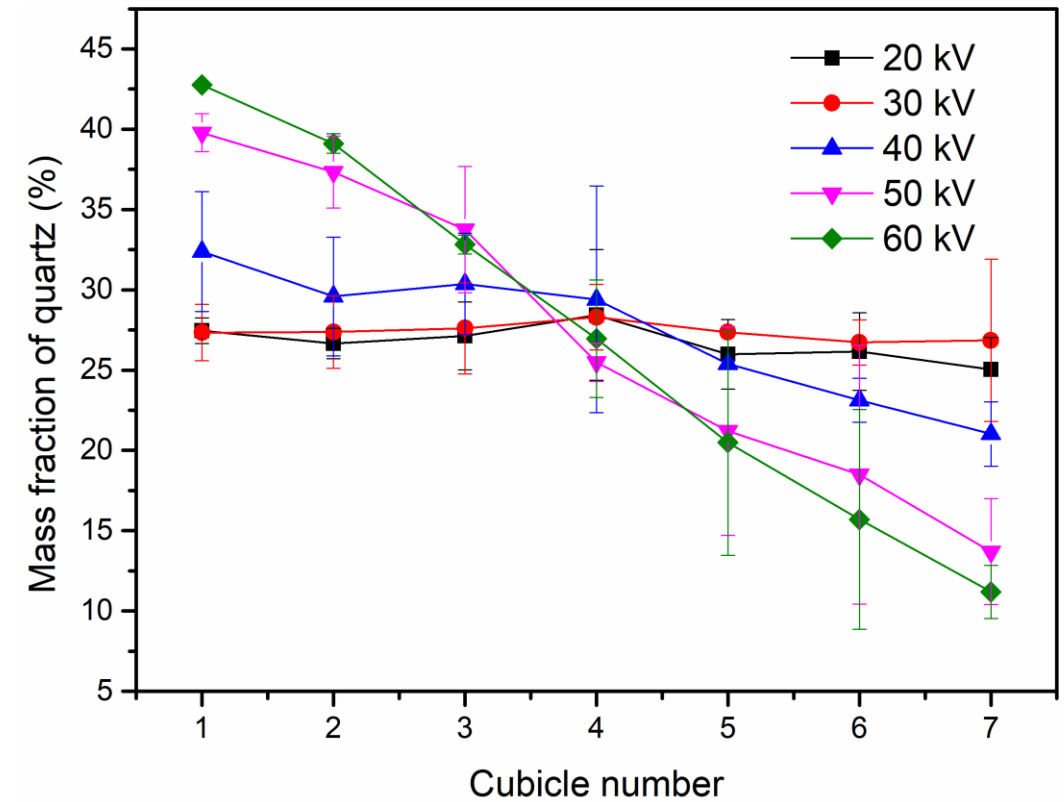


Fig.8 Separating coal-quartz mixture at different high voltages
(gas velocity: 16.53 cm/s; Fluidization time: 30 min)

Increasing voltage results in better separation effect.

Gas velocity

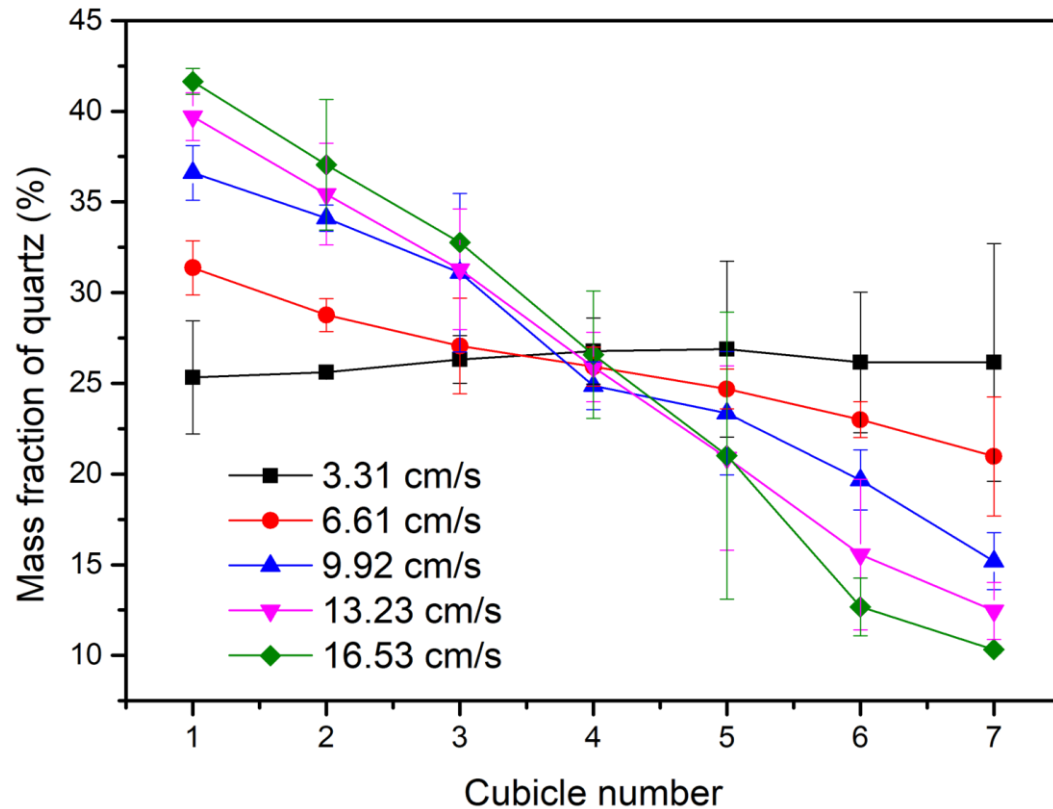


Fig.9 Separating coal-quartz mixture with different gas velocities
(high voltage: 60 kV; Fluidization time: 30 min)

Higher gas velocity leads to better separation result.

Fluidization time

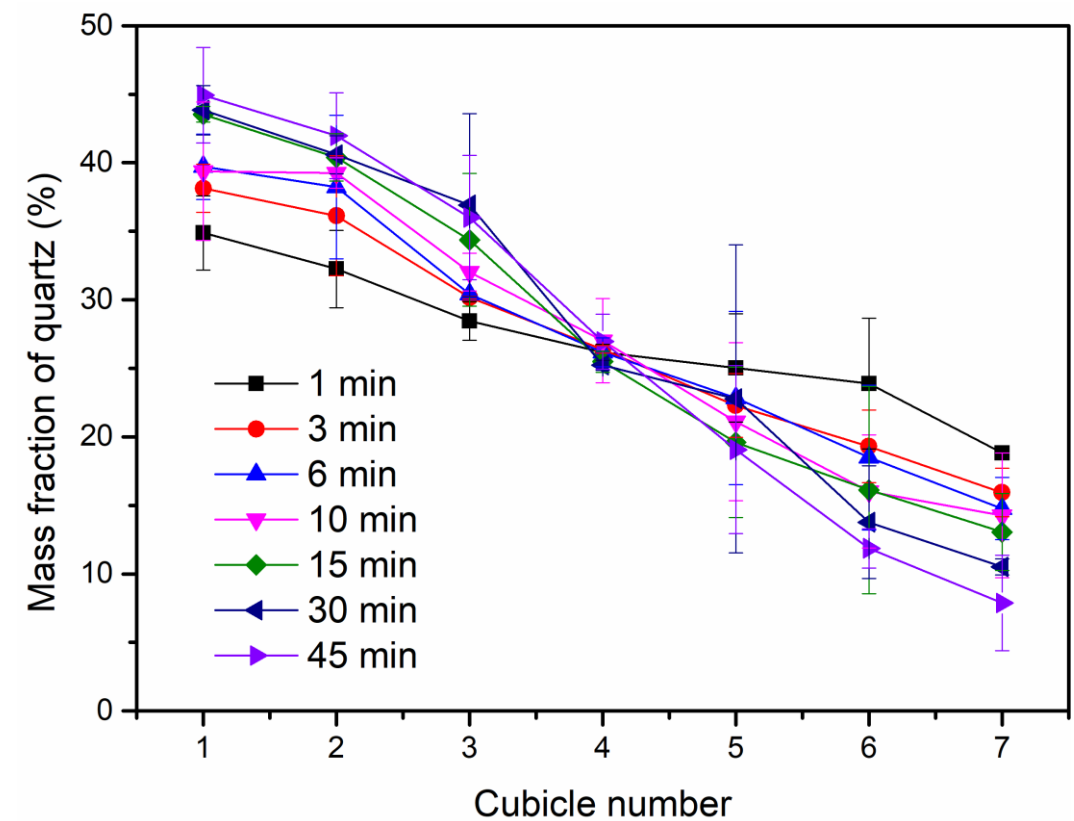
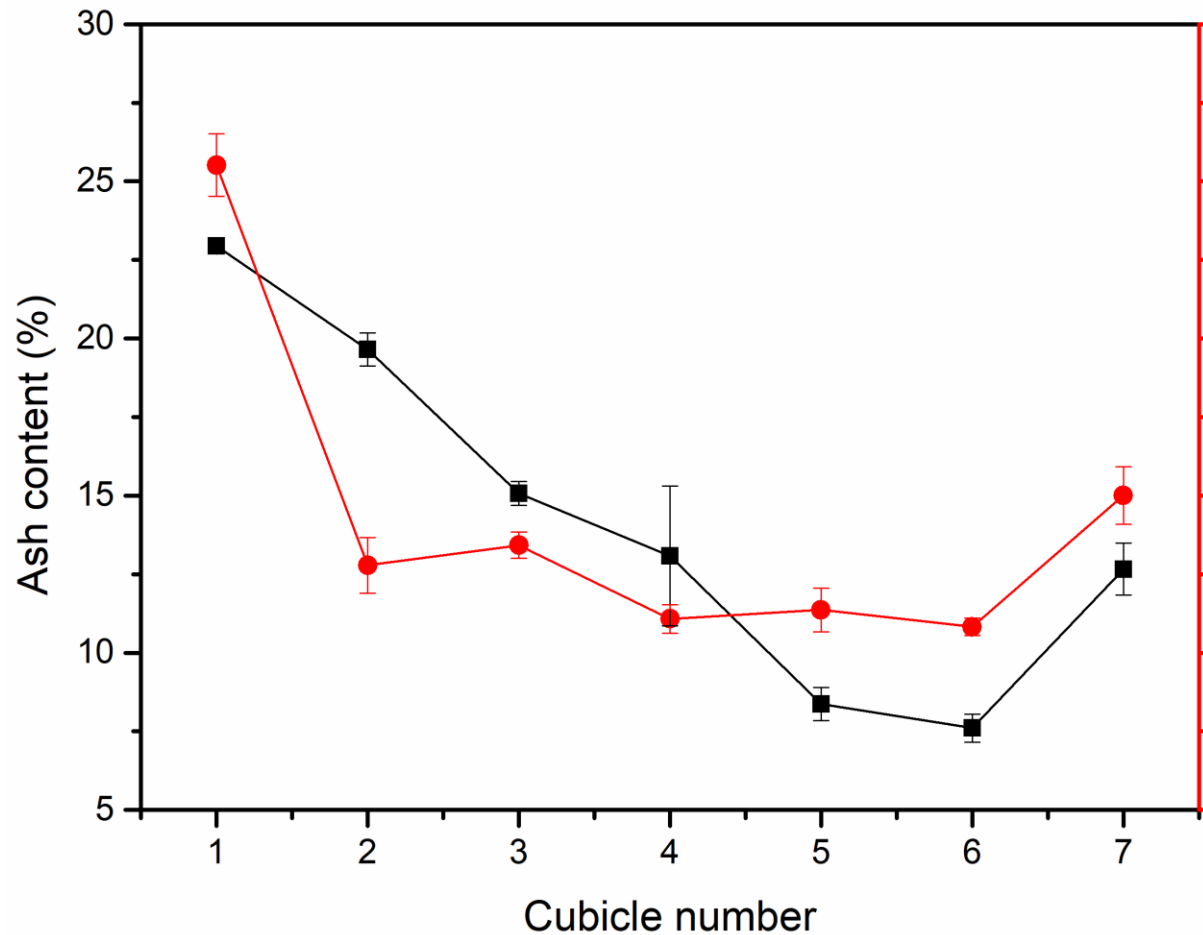


Fig.10 Separating coal-quartz mixture at different fluidization time
(gas velocity: 16.53 cm/s; high voltage: 60 kV)

No visible separation difference after 15 min.

Enrichment of raw coal



It is feasible to remove minerals from coal using fluidized bed with applied electrical field.

Ash content can reduce from 15.61% to 7.29%.

More than a quarter of yields were high ash content products.

Fig.11 Separating raw coal using fluidized bed with applied electric field

(1)

Tribocharging quartz with coal: Quartz can easily be given a negative charge; it should be easy to give coal a positive charge.

(2)

A novel device that integrating fluidized bed and high voltage plate was proposed to separate coal from its gangue minerals.

(3)

The conditions of 60 kV voltage, 16.53 cm/s gas velocity and 15 min fluidization time were found to be feasible operating parameters for separating coal-quartz mixture.

(4)

Ash content could be reduced from 15.61% to 7.29%, and more than a quarter of yields were high ash content products.

Tribocharging at nanoscale

AFM & KPFM

In situ method to quantitatively characterize the triboelectrification at nanoscale via a combination of atomic force microscopy (AFM) and Kelvin probe force microscopy (KPFM).

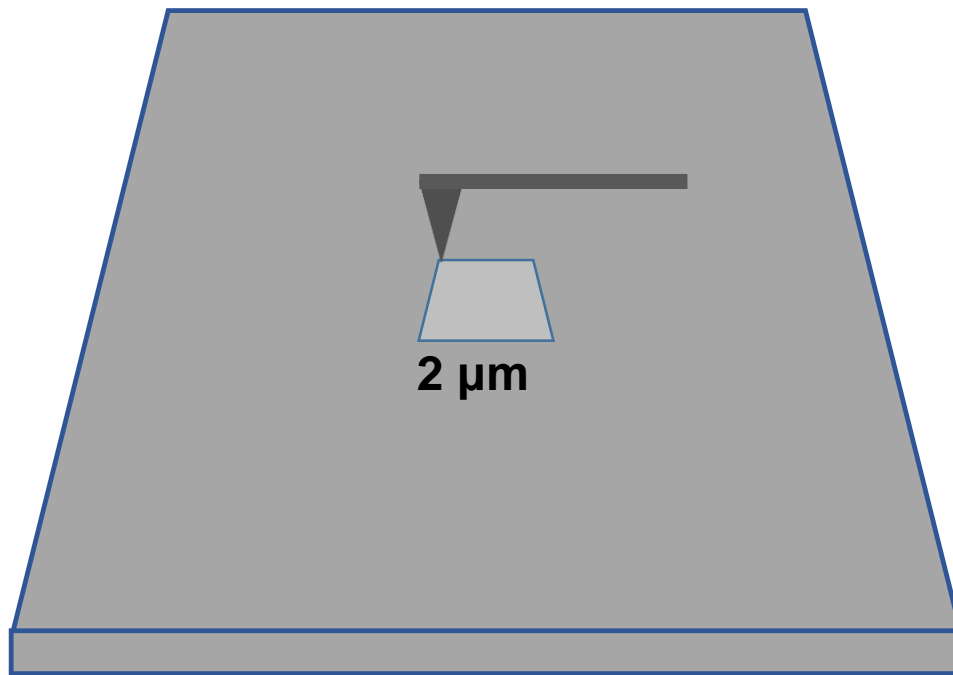


Fig.12 Contact electrification using AFM

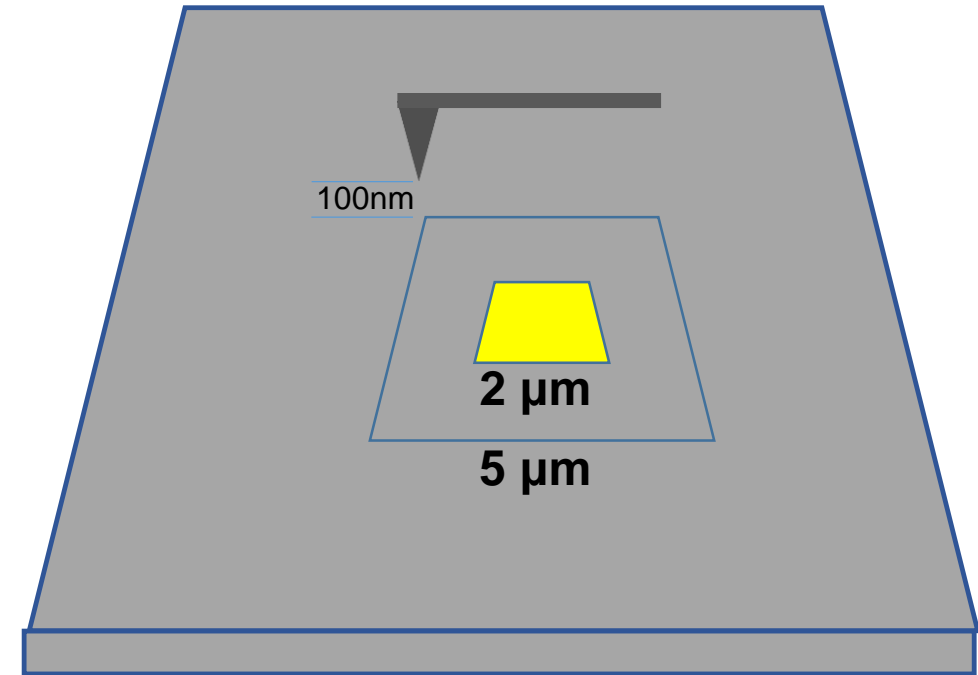


Fig.13 Surface potential measurement using KPFM



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Thanks for your attention